

Final report for NASA grant NAG5-1798:
"ROSAT-IUE Observations of Symbiotics Stars, and, "The X-Ray Morphology of High Latitude Associations

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Covering the period through 10/31/93.

OBJECTIVES:

The purposes of this grant included:

1. to provide for continuing investigations of the x-ray properties of a class of interacting binaries known as symbiotic stars, through analysis of their detection statistics in the ROSAT All-Sky Survey and simultaneous IUE observations;
2. to obtain and analyze ROSAT images of selected high latitude OB star associations, in order to permit multi-wavelength dissection of their contents and energetics.

The first study is expected to result in enhanced information on mass transfer and accretion in such systems, and provide a more quantitative basis for interpretation of the spectra of these and similar stellar and extragalactic systems. This particular effort represents NASA support for an approved collaboration between the PI and the ROSAT Team at MPE Garching.

In the second study, we seek to correlate the strength with which the diffuse clouds have been shocked and the recent star formation triggered, namely, the O and B stars of the Association, as well as nearby T Tauri stars. The large scale X-ray emission in deep ROSAT PSPC images will be compared with the optical, infrared and radio topology of nearby supernova remnants, molecular clouds and the distribution of massive stars in the regions. This should enable us to test whether the star formation triggering shocks originate from in the galactic plane (nearby supernovae) or from the collision of infalling matter with the disk material (galactic fountain dynamics).

DURING THE PAST 24 MONTHS:

1. Grant initiated Nov. 1, 1991.
2. Visited MPE during Jan.92 for the purpose of writing summary of detected sources using SASS processed results. Substantial progress on first draft which combines with IUE observations [abstract was appended to a previous progress report].
3. Collected WFC and PSPC and archival Voyager data on AG Dra, and began emission measure analysis with intent to resolve source temperature. Work on this continuing.
4. Received observation tape of the Per OB2 association during March.92 and coached collaborator/grad student Jon Saken on ROSAT mysteries. He has begun extracting data from the tape and making comparisons with images, e.g. IRAS, from other wavelengths [examples appended to previous report].
5. Progress on revision of joint paper on Symbiotics X-ray and IUE observation interpretation, although an argument among authors has slowed progress. Begun work on Symbiotics X-ray detection in the sky survey statistics paper.
6. Multi-wavelength analysis of the Per OB2 data leads us to believe that there is no supernova

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remnant apparent in the PSPC data, nor in the IRAS images of the region, based on color temperature comparisons with other SNR. The origin of this high latitude association remains in question.

7. Given an early indication of AO3 selections, I organized an optical monitoring campaign for the brightest X-ray symbiotic, AG Dra, and arranged to get additional new IUE and Voyager observations during summer 1992.

8. Continued collaborative communication with MPE. Tom Fleming's departure from MPE (11/92) further reduced the pace of this study.

9. Reconfirmed nature of collaborative access to All-Sky Survey data on symbiotics with communications to J.Schmitt at MPE, following job transition by K.Bickert to infrared group at MPE.

10. Participated in ROSAT NASA AO-4 proposal review, April 1993.

11. Expended effort for completing 2d paper on Symbiotics detection statistics with Bickert, although his job change to the infrared group at MPE did seriously handicap progress on this. Still intend to summarize all upper limits from sky survey data.

12. Participation in the AO4 review brought out interesting CO mapping of the Per OB2 region by Langer et al., which is crucial information for interpreting the limited PSPC coverage I obtained.

13. A summary of PSPC AO2 results on both Per OB2 and Cep OB4 associations observations is being developed for publication.

14. Continued collaborative communications with MPE.

15. The expected demise of PSPC late this year suggests it will be timely to begin searching the archives for other relevant observations, as time permits.

PUBLICATIONS CITING SUPPORT OF NAG5-1798:

1."ROSAT ALL-SKY SURVEY DETECTIONS OF SYMBIOTIC BINARIES"

K.Bickert, R.Stencel, E. Brugel, S.Kenyon, T.Fleming and J.Schmitt
1993 Astron. Astrophys. (Letters) - in press.

2."ROSAT PSPC AND WFC DETECTIONS OF AG DRACONIS"

R.E.Stencel, A.Brown, K.Bickert, T.Fleming, J.Schmitt, G.Bromage, J.Pye, R.Polidan and R.Viotti
1993 ApJ in preparation.

3."IUE AND ROSAT SKY SURVEY OBSERVATIONS OF THE SYMBIOTIC STARS CH CYG, R AQR AND AG DRA"

R.Viotti et al. (incl. R.Stencel)
1993 Astron.Astrophys., in preparation.

4."THE DYNAMICS OF THE PER OB2 AND CEP OB4 ASSOCIATIONS"

J.Saken, R.Stencel and C.D.Garmany
1992 Ap.J. in preparation.